

# Finisar

## Preliminary Product Specification

### DWDM SFP Transceiver

#### FWDM-1629-XX

#### PRODUCT FEATURES

- Up to 1.25 Gb/s bi-directional data links
- Hot-pluggable SFP footprint
- Temperature-stabilized DWDM-rated DFB laser transmitter
- 100GHz ITU Grid, C Band
- Low dispersion DFB laser suitable
- Metal enclosure for low EMI
- Extended operating range: -5°C to 70°C case temperature
- Wavelength controlled within  $\pm 0.1$  nm over life and temperature
- Extended link budget with APD receiver technology
- GbE and 1X FC compliant



#### APPLICATIONS

- Amplified DWDM networks
- Bandwidth aggregation
- Ring topologies with OADM

Finisar's Dense Wavelength-Division Multiplexing (DWDM) transceivers offer DWDM transport with dramatically lower power and cost in a standard pluggable Small Form Factor Pluggable (SFP) package. The FWDM-1629 is designed expressly for service providers deploying DWDM networking equipment in metropolitan Ethernet and SAN networks. The fiber link budget has been enhanced to 30dB with an Avalanche Photo Diode (APD) receiver.

In addition, digital diagnostic features are implemented as described in Finisar Application Note AN-2030, "Digital Diagnostic Monitoring Interface for Optical Transceivers"<sup>2</sup>.

# Finisar

## PRODUCT SELECTION

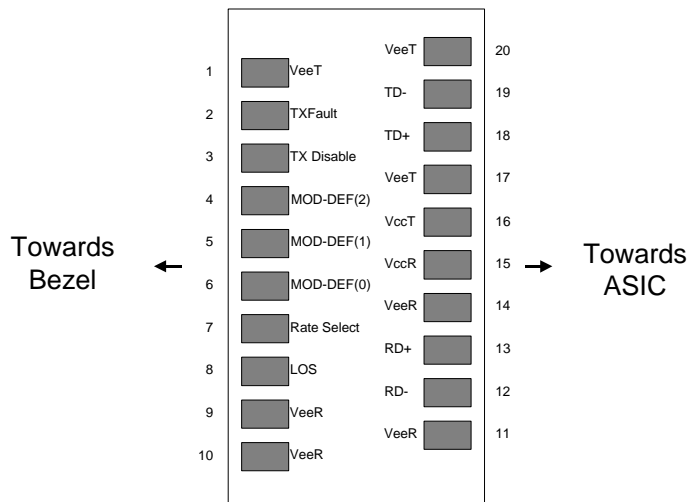
Product Code	Frequency (THz)	Center Wavelength (nm)
FWDM -1629-17	191.7	1563.86
FWDM -1629-18	191.8	1563.05
FWDM -1629-19	191.9	1562.23
FWDM -1629-20	192.0	1561.42
FWDM -1629-21	192.1	1560.61
FWDM -1629-22	192.2	1559.79
FWDM -1629-23	192.3	1558.98
FWDM -1629-24	192.4	1558.17
FWDM -1629-25	192.5	1557.36
FWDM -1629-26	192.6	1556.55
FWDM -1629-27	192.7	1555.75
FWDM -1629-28	192.8	1554.94
FWDM -1629-29	192.9	1554.13
FWDM -1629-30	193.0	1553.33
FWDM -1629-31	193.1	1552.52
FWDM -1629-32	193.2	1551.72
FWDM -1629-33	193.3	1550.92
FWDM -1629-34	193.4	1550.12
FWDM -1629-35	193.5	1549.32
FWDM -1629-36	193.6	1548.51
FWDM -1629-37	193.7	1547.72
FWDM -1629-38	193.8	1546.92
FWDM -1629-39	193.9	1546.12
FWDM -1629-40	194.0	1545.32
FWDM -1629-41	194.1	1544.53
FWDM -1629-42	194.2	1543.73
FWDM -1629-43	194.3	1542.94
FWDM -1629-44	194.4	1542.14
FWDM -1629-45	194.5	1541.35
FWDM -1629-46	194.6	1540.56
FWDM -1629-47	194.7	1539.77
FWDM -1629-48	194.8	1538.98
FWDM -1629-49	194.9	1538.19
FWDM -1629-50	195.0	1537.40
FWDM -1629-51	195.1	1536.61
FWDM -1629-52	195.2	1535.82
FWDM -1629-53	195.3	1535.04
FWDM -1629-54	195.4	1534.25
FWDM -1629-55	195.5	1533.47
FWDM -1629-56	195.6	1532.68
FWDM -1629-57	195.7	1531.90
FWDM -1629-58	195.8	1531.12
FWDM -1629-59	195.9	1530.33
FWDM -1629-60	196.0	1529.55
FWDM -1629-61	196.1	1528.77

**I. Pin Descriptions**

Pin	Symbol	Name/Description	Ref.
1	V <sub>EET</sub>	Transmitter Ground (Common with Receiver Ground)	1
2	T <sub>FAULT</sub>	Transmitter Fault	
3	T <sub>DIS</sub>	Transmitter Disable. Laser output disabled on high or open	2
4	MOD_DEF(2)	Module Definition 2. Data line for Serial ID	3
5	MOD_DEF(1)	Module Definition 1. Clock line for Serial ID	3
6	MOD_DEF(0)	Module Definition 0. Grounded within the module	3
7	Rate Select	No connection required	4
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation	5
9	V <sub>EER</sub>	Receiver Ground (Common with Transmitter Ground)	1
10	V <sub>EER</sub>	Receiver Ground (Common with Transmitter Ground)	1
11	V <sub>EER</sub>	Receiver Ground (Common with Transmitter Ground)	1
12	RD-	Receiver Inverted DATA out. AC Coupled	
13	RD+	Receiver Non-inverted DATA out. AC Coupled	
14	V <sub>EER</sub>	Receiver Ground (Common with Transmitter Ground)	1
15	V <sub>CCR</sub>	Receiver Power Supply	
16	V <sub>CCT</sub>	Transmitter Power Supply	
17	V <sub>EET</sub>	Transmitter Ground (Common with Receiver Ground)	1
18	TD+	Transmitter Non-Inverted DATA in. 100 ohm termination between TD+ and TD-, AC Coupled thereafter	
19	TD-	Transmitter Inverted DATA in. See TD+	
20	V <sub>EET</sub>	Transmitter Ground (Common with Receiver Ground)	1

Notes:

- Circuit ground is internally isolated from chassis ground.**
- Laser output disabled on T<sub>DIS</sub> >2.0V or open, enabled on T<sub>DIS</sub> <0.8V.
- Should be pulled up with 4.7k – 10kohms on host board to a voltage between 2.0V and 5.5V. MOD\_DEF(0) pulls line low to indicate module is plugged in.
- Finisar 2x receiver achieves simultaneous 1x and 2x operation without active control.
- LOS is open collector output. Should be pulled up with 4.7k – 10kohms on host board to a voltage between 2.0V and 5.5V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.



**Diagram of Host Board Connector Block Pin Numbers and Names****II. Absolute Maximum Ratings**

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	V <sub>cc</sub>	-0.5		4.7	V	
Storage Temperature	T <sub>S</sub>	-10		85	°C	
Case Operating Temperature	T <sub>OP</sub>	-5		70	°C	

**III. Electrical Characteristics (T<sub>OP</sub> = -5 to 70 °C, V<sub>CC</sub> = 3.13 to 3.50 Volts)**

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	V <sub>cc</sub>	3.13	3.30	3.50	V	
Supply Current	I <sub>cc</sub>			305	mA	
Inrush Current	I <sub>surge</sub>			I <sub>cc</sub> +30	mA	
Maximum Power	P <sub>max</sub>			1.0	W	
<b>TRANSMITTER</b>						
Input differential impedance	R <sub>in</sub>		100		Ω	1
Single ended data input swing	V <sub>in,pp</sub>	250		1200	mV	
Transmit Disable Voltage	V <sub>D</sub>	V <sub>cc</sub> – 1.3		V <sub>cc</sub>	V	
Transmit Enable Voltage	V <sub>EN</sub>	V <sub>ee</sub>		V <sub>ee</sub> + 0.8	V	2
<b>RECEIVER</b>						
Single ended data output swing	V <sub>out,pp</sub>	175		1000	mV	3
Data output rise time	t <sub>r</sub>			150	ps	4
Data output fall time	t <sub>f</sub>			150	ps	4
LOS Fault	V <sub>LOSfault</sub>	V <sub>cc</sub> – 0.5		V <sub>ccHOST</sub>	V	5
LOS Normal	V <sub>LOSnorm</sub>	V <sub>ee</sub>		V <sub>ee</sub> +0.5	V	5
Power Supply Rejection	PSR	100			mVpp	6

**Notes:**

1. Connected directly to TX data input pins. AC coupled thereafter.
2. Or open circuit.
3. Into 100 ohms differential termination.
4. 20 – 80 %
5. Loss Of Signal is LVTTTL. Logic 0 indicates normal operation; logic 1 indicates no signal detected.
6. Receiver sensitivity is compliant with power supply sinusoidal modulation of 20 Hz to 1.5 MHz up to specified value applied through the recommended power supply filtering network.

**IV. Low Speed Signals**

Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
RX_LOS Assert Level		-42	-36		dBm	
RX_LOS Deassert Level			-34	-32	dBm	
RX_LOS Hysteresis		0.5	2		dB	
RX_LOS Assert Delay	t_loss_on			100	μsec	From detection of loss of signal to assertion of RX_LOS
RX_LOS Negate Delay	t_loss_off			100	μsec	From detection of presence of signal to negation of RX_LOS
TX_DISABLE Assert Time	t_off			10	μsec	Rising edge of TX_DISABLE to fall of output signal below 10% of nominal
TX_DISABLE Negate Time	t_on			1000	μsec	Falling edge of TX_DISABLE to rise of output signal above 90% of nominal. Time indicated is under steady-state temperature conditions.
TX_DISABLE Reset Time	t_reset	10			μsec	TX_DISABLE HIGH before TX_DISABLE set LOW
TX_FAULT Assert		-0.2		+0.2	nm	TX_Fault will assert before the device is outside of specified wavelength range

**V. Optical Parameters**

Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
<b>TRANSMITTER CHARACTERISTICS</b>						
Center Wavelength Spacing			100		GHz	Corresponds to approximately 0.8 nm
Spectral Width	$\Delta\lambda_{20}$		0.2	0.3	nm	Full width, -20dB from max
Transmitter Center Wavelength – End of Life	$\lambda_c$	X - 100	X	X + 100	pm	X = specified center wavelength
Transmitter Center Wavelength – Start of Life	$\lambda_c$	Y - 25	Y	Y + 25	pm	Y = X – 60pm
Side Mode Suppression Ratio (SMSR)	SMSR	30			dB	Modulated
Optical Rise/Fall Time	$t_r / t_f$			200	ps	Unfiltered, 80% -20%
Transmitter Optical Output Power	$P_{out}$	0		+4	dBm	Average power coupled into single mode fiber
Transmitter Extinction Ratio	OMI	9.0			dB	
Transmitter Eye Opening		40			%	IEEE 802.3 and Fibre Channel Eye Mask Margin
Relative Intensity Noise	RIN			-120	dB/Hz	
Dispersion Penalty at 180km				3.0	dB	3600ps/nm. See Note 3.
<b>RECEIVER CHARACTERISTICS</b>						
Optical Input Wavelength	$P_{in}$	1520		1570	nm	
Receiver Jitter Generation				100	ps	Peak to peak, -25 dBm Rx power
Optical Input Power (BER < 10 <sup>-9</sup> )	$P_{in}$	-32		-9	dBm	1.25 Gb/s w/ PRBS 2 <sup>7</sup> -1
Optical Input Power (BER < 10 <sup>-12</sup> )	$P_{in}$	-30		-9	dBm	1.25 Gb/s w/ PRBS 2 <sup>7</sup> -1
Optical Input Power – Receiver Damage Threshold				6	dBm	
Receiver Reflectance	$R_{RX}$			-27	dB	
OSNR Limit	$OSNR_{min}$	20			dB	
OSNR Penalty				2.0	dB	For OSNR = $OSNR_{min}$ . See Note 4.

Notes:

- Parameters are specified over temperature and voltage, at end of life unless otherwise noted.
- All parameters are measured on a Finisar SFP Evaluation Card unless otherwise noted.
- Dispersion penalty is measured in loop back with OSNR set at  $Rx \leq 28$  dB. Data rate and pattern used same as specified for Optical Input Power. Dispersion penalty is measured at  $BER = 10^{-10}$
- OSNR penalty is measured in loop back. Data rate and pattern used is same as specified for Optical Input Power. OSNR penalty is measured at  $BER = 10^{-10}$

**VI. Wavelength Stabilization**

The laser transmitter will not be turned on until its temperature is adjusted to ensure operation within the specified channel ( $X \pm 0.4\text{nm}$ ). This temperature stabilization time is dependent on the ambient temperature conditions, but will typically occur within 90 seconds of powering the device. The device will transmit within the specified wavelength tolerance ( $X \pm 0.1\text{nm}$ ) within 5 seconds of transmitter operation.

**VII. General Specifications**

Parameter	Symbol	Min	1.25	Max	Units	Notes/Conditions
Data Rate	BR	1.06		1.25	Gb/sec	Fibre Channel, IEEE 802.3 compatible
Total System Budget		30	32		dB	@ 1.25 Gb/s, BER $<10^{-12}$ w/ PRBS $2^7-1$ . See Note 1

Note 1: Total system budget is defined as  $P_{\text{out}} - P_{\text{in}}$  – typical connector losses.

**VIII. Environmental Specifications**

Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
Operating Temp	$T_{\text{op}}$	-5		70	°C	Case temperature measured on top-side of device
Storage Temp	$T_{\text{sto}}$	-10		85	°C	Ambient temperature
Eye Safety						CDRH and IEC-825 Class 1 Laser Product. See Note 1

Note 1: Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.

**IX. Serial Communication Protocol**

All Finisar SFPs support the 2-wire serial communication protocol outlined in the SFP MSA<sup>1</sup>. These SFPs use an Atmel AT24C01A 128 byte E<sup>2</sup>PROM with an address of A0h. For details on interfacing with the E<sup>2</sup>PROM, see the Atmel data sheet titled “AT24C01A/02/04/08/16 2-Wire Serial CMOS E<sup>2</sup>PROM.”<sup>4</sup>

Finisar’s DWDM SFPs also support extended diagnostic features as described in Finisar Applications Note AN-2030, “Digital Diagnostic Monitoring Interface for Optical Transceivers”<sup>2</sup>. A controller IC that monitors system parameters such as laser current, module temperature, transmitter power, and received power is accessible at address A2H.

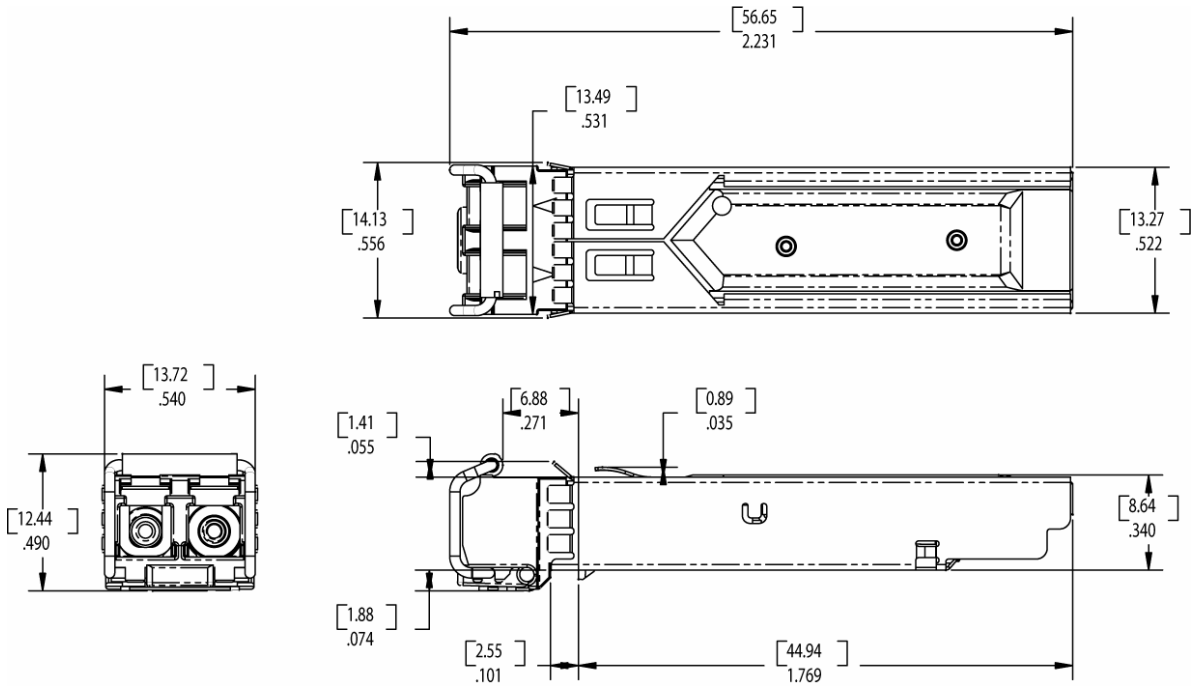
Parameter	Symbol	Min	Typ	Max	Units	Notes/Conditions
I <sup>2</sup> C Clock for Atmel (A0H) and Controller IC (A2H)	C <sub>atmel</sub>	0		100,000	Hz	Bus can be driven blind.

( E<sup>2</sup>PROM Description TBD pending MSA)



**X. Mechanical Specifications**

Finisar’s Multi-rate DWDM Small Form Factor Pluggable (SFP) transceivers are compatible with the dimensions defined by the SFP Multi-Sourcing Agreement (MSA).



**Figure 1. DWDM SFP Outline Drawing**

**XI. Ordering Information**

<b>Part Number</b>	<b>Description</b>
FWDM-1629-XX	DWDM SFP with APD Receiver XX = channel number (see product selection on page 2)

**XII. References**

1. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000. Documentation is currently available from Finisar upon request.
2. “Application Note AN-2030: Digital Diagnostic Monitoring Interface for Optical Transceivers”, Finisar Corporation, April 2002.
3. “AT24C01A/02/04/08/16 2-Wire Serial CMOS E<sup>2</sup>PROM”, Atmel Corporation.  
[www.Atmel.com](http://www.Atmel.com)
4. “Digital Diagnostic Monitoring Interface For Optical Transceivers Rev 6.1”, September, 2004. Documentation is currently available from Finisar upon request.

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